APPLICATION FOR UNITED STATES LETTERS PATENT

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for

MULTIFUNCTION HANDLE FOR A REMOVABLE STORAGE OR OTHER REMOVABLE COMPUTER DEVICES

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MULTIFUNCTION HANDLE FOR A REMOVABLE STORAGE OR OTHER REMOVABLE COMPUTER DEVICES

TECHNICAL FIELD

[001] The present application relates generally to computer systems, and more specifically to removable mass storage or other types of removable devices for computer or other electronic systems.

BACKGROUND OF THE INVENTION

[002] Modern computer systems include mass storage devices such as hard drives for storing application programs to be executed by the computer system, and for storing data utilized by such programs as well as other data desired to be stored by users of the system. A hard disk is a magnetic disk on which data is stored, and the storage density of a hard disk is the amount of data that can be stored in a given area of the disk. As the storage density of hard drives has increased, meaning that more data can be stored on smaller disks, physically smaller drives having relatively large storage capacities have become possible.

[003] Physically smaller hard drives have led to removable drives, where a removable drive is a hard drive that can easily be plugged into and removed from a drive bay in the computer system. Removable hard drives make it easier to back up data and to transfer data from one computer to another, and also enable a user to more easily replace a defective drive and to upgrade software for the computer system. Furthermore, removable drives provide improved data security in many environments because a removable drive can be removed from the associated computer system and stored in a safe location when desired. Hard drives are the type of removable device being discussed herein merely for ease of description, and one skilled in the art will appreciated that the principles described herein apply equally well to other types of mass storage devices such as magnetic-tape drives, CD-ROM drives, and DVD drives, as well as to other types of removable devices.

[004] Various mechanical configurations for the removable drive and the drive bay into which the drive is inserted are currently utilized. For example, **FIG. 1** is an

isometric drawing illustrating a portion of a conventional computer system ***100*** including a removable drive ***102*** that fits into a drive bay ***104***. A handle ***106*** includes pins ***108***, ***110*** that fits into respective holes ***112***, ***114*** within the drive bay ***104*** as illustrated by lines ***116***, ***118***, and further includes pinion teeth ***120*** formed near the pins ***108***, ***110***. The handle ***106*** rotates about axes of the pins ***108***, ***110*** when inserted into the holes ***112***, ***114***. A pair of guide tracks ***121*** are positioned within the drive bay ***104*** such that when the removable drive ***102*** is inserted into the drive bay a pair of guide rails ***122*** (only one shown in **FIG. 1**) rest upon the guide tracks. Each of the guide rails ***122*** includes track teeth ***124*** formed on the rail near a front end ***126*** of the removable drive ***102***. The removable drive ***102*** further includes a key lock ***127*** positioned on the front end ***126*** that controls a rod ***129*** to either extend through an opening ***131*** in a side of the removable drive in a direction indicated by an arrow ***133*** or to retract the rod within the opening. When the removable drive ***102*** is completely inserted within the drive bay ***104***, the key lock ***127*** is activated to cause the rod ***129*** to extend into a hole (not shown) within the bay to thereby prevent removal of the drive from the bay. In this way, the key lock ***127*** and rod ***129*** operate in combination to form an interlock mechanism that prevents removal of the drive ***102*** from the bay ***104*** when activated.

[005] In operation, to insert the removable drive ***102*** into the drive bay ***104*** the handle ***106*** is first rotated clockwise about the axis of the pins ***108***, ***110*** to position a top cross-member ***128*** of the handle above an opening of the drive bay. The key lock ***127*** is deactivated at this point, causing the rod ***129*** to retract within the opening ***131*** in the side of the drive. The removable drive ***102*** is then inserted into the drive bay ***104*** and the guide rails ***122*** of the removable drive ride upon the guide tracks ***121*** within the drive bay. The removable drive ***102*** is pushed towards a back of the drive bay ***104*** in a direction indicated by an arrow ***130***, with the guide rails ***122*** sliding upon the guide tracks ***121*** until the track teeth ***124*** of the guide rails engage the pinion teeth ***120*** of the handle ***106***.

[006] At this point, as the removable drive continues to be pushed into the drive bay ***104*** in the direction indicated by the arrow ***130***, the handle ***106*** begins rotating counterclockwise about the axes of the pins ***108***, ***110***. A person inserting the

removable drive ***102*** at this point grabs the top cross-member ***128*** of the handle ***106*** and applies force to continue the handle rotating counterclockwise and thus towards a bottom of the drive bay ***104*** in a circular arc. As the handle ***106*** is rotated counterclockwise, the pinion teeth ***120*** of the handle engage the track teeth ***124***, pushing the removable drive ***102*** towards the back of the drive bay. Electrical connectors (not shown) on a back of the removable drive ***102*** are coupled to electrical connectors (not shown) at the back of the drive bay ***104*** as the handle ***106*** is rotated counterclockwise to electrically interconnect the removable drive to the computer system ***100*** and thereby complete insertion of the removable drive into the drive bay.

[007] With the removable drive ***102*** completely inserted into the drive bay ***104***, the top cross-member ***128*** of the handle ***106*** is positioned either across the opening defined by the drive bay ***104*** adjacent a front end ***126*** of the removable drive ***102*** are below the opening defined by the drive bay, depending upon the precise physical structure of the handle. At this point, the key lock ***127*** is activated causing the rod ***129*** to extend outward in a direction indicated by the arrow ***133*** and into the corresponding hole in the side of the drive bay to thereby lock the drive into the bay and prevent removal of the drive.

[008] Once inserted into the drive bay ***104***, the drive ***102*** cannot be randomly removed from the bay, or data stored on the disk and other problems with computer system ***100*** could result, as will be appreciated by those skilled in the art. For example, an operating system running on the computer system ***100*** may store in cache memory within the computer system some type of file system information structure of the drive ***102***, such as a file allocation table (FAT) in a Windows system. The file system information structure is a data structure that the operating system uses to locate files on the drive 102, such as the FAT, for example, which corresponds to a table indicating the location of files on the drive. If the drive ***102*** is pulled out before the current file system information structure stored in cache is transferred to the drive, then the operating system may not know where files are located on the drive and improper operation of the computer system ***100*** may result (e.g., the system could lock up or crash).

[009] When completely inserted into the drive bay ***104*** and the key lock ***127*** activated, a user could grab the top cross-member ***128*** of the handle and rotate the handle clockwise in an attempt to remove the drive. In this situation, the user could, through the leverage provided by the handle ***106***, inadvertently break the rod ***129*** and remove the drive ***102***. Not only would this break the rod ***129*** and possibly damage the drive ***102***, but the drive could be removed at the wrong time, resulting in loss of data on the drive and/or improper operation of the system ***100***. As a result of the possibility of damaging the drive ***102*** and rod ***129***, many drives simply do not include interlock mechanisms such as the key lock ***127*** and rod ***129***, leaving open the possibility of removing the drive at the wrong time and losing data.

[010] There is need for a system and method of inserting removable drives into a computer system and preventing removal of such drives at undesirable times.

SUMMARY OF THE INVENTION

[011] According to one aspect of the present invention, a removable device, such as a removable mass storage device, includes a multifunction handle coupled to the device. The multifunction handle includes a force-developing portion and includes an interlock portion adapted to be engaged by an interlock component. The handle develops an insertion force at the force-developing portion responsive to a force applied to the handle, and also secures the removable device in a desired position to prevent use of the handle responsive to the interlock portion being engaged by the interlock component.

BRIEF DESCRIPTION OF THE DRAWINGS

[012] **FIG. 1** is an isometric drawing illustrating a conventional mechanical structure of a removable disk that fits into a drive bay of a computer system.

[013] **FIG. 2** is an isometric drawing of a removable drive including a multifunction handle and interlock mechanism according to one embodiment of the present invention.

[014] **FIG. 3** is an isometric drawing showing the multifunction handle of **FIG. 2** rotated relative to the position in **FIG. 2** and showing insertion cams formed on the handle.

[015] **FIG. 4** is an isometric view illustrating the removable drive of **FIG. 2** within a cross-section of a drive bay and showing in more detail the interlock mechanism according to one embodiment of the present invention.

[016] **FIGS. 5A** and **5B** are cross-sectional views illustrating the operation of the multifunction handle of **FIG. 2** in inserting the removable drive within the drive bay of **FIG. 4**.

[017] **FIG. 6** is a functional block diagram of a computer system including the removable drive and drive bay of **FIG. 4** according to one embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[018] **FIG. 2** is an isometric drawing of a removable drive ***200*** including a multifunction handle ***202*** and an interlock mechanism ***204*** according to one embodiment of the present invention. The interlock mechanism ***204*** includes, in part, an opening ***206*** in the handle and an opening ***208*** in a side ***209*** of the removable drive ***200***. In operation, the handle ***202*** functions to assist a user in inserting the removable drive ***200*** within a drive bay (not shown) and the interlock mechanism ***204*** functions to prevent the use of the handle and thereby prevent removal of the drive when the interlock mechanism is engaged, as will be described in more detail below. In this way, the handle ***202*** provides three functions: 1) insertion and removal of the drive ***200*** into and from a drive bay; 2) interlock to prevent removal of the drive; and 3) carrying handle when the drive is not inserted in a drive bay.

[019] In the following description, certain details are set forth in conjunction with the described embodiments of the present invention to provide a sufficient understanding of the invention. One skilled in the art will appreciate, however, that the invention may be practiced without these particular details. Furthermore, one skilled in the art will appreciate that the example embodiments described below do

not limit the scope of the present invention, and will also understand that various modifications, equivalents, and combinations of the disclosed embodiments are within the scope of the present invention. Finally, the operation of well known components or conventional techniques have not been shown or described in detail below to avoid unnecessarily obscuring the present invention.

[020] In the example of **FIG. 2**, the handle ***204*** includes a front member ***210***, a back member ***212***, a side member ***214***, and a side member ***216*** in which the opening ***206*** is formed. The handle ***204*** is attached to a housing ***218*** of the removable drive ***200*** to rotate about an axis ***300*** as shown in **FIG. 3**, which is an isometric drawing showing the multifunction handle ***204*** rotated relative to the position of the handle in **FIG. 2**. An arrow ***302*** indicates the rotation of the handle ***204*** about the axis ***300*** in a downward direction and an arrow ***304*** indicates rotation of the handle in an upward direction. The handle ***204*** further includes insertion cams ***306*** extending from the back member ***212*** that function to apply an insertion force to a drive bay (not shown) into which the drive ***200*** is being inserted when the front member ***210*** of the handle is pushed downward, as will be described in more detail below. One skilled in the art will understand that the handle ***204*** may be mounted to the housing ***218*** to allow the insertion cams ***306*** to extend through a front panel ***308*** and a top panel ***310*** of the housing in a variety of different ways, and **FIGS. 2** and **3** merely functionally illustrate the interconnection between the two.

[021] **FIG. 4** is an isometric view illustrating the removable drive ***200*** of **FIG. 2** within a cross-section of a drive bay ***400*** and showing in more detail the interlock mechanism ***204*** according to one embodiment of the present invention. The interlock mechanism ***204*** includes a solenoid ***402*** having a base ***404*** and a rod ***406***, with the base being positioned so that the rod extends and retracts through the hole ***208*** (**FIG. 3**) and through the hole ***206*** in the handle ***202***. The interlock mechanism ***402*** is also shown above the drive bay ***400*** and removable drive ***200*** to better illustrate the operation of the mechanism. The upper depiction of the interlock mechanism ***402*** shows the rod ***206*** in a retracted position to withdraw the rod from the holes ***206***, ***208***, such as during insertion and removal of the drive ***200*** from the

drive bay ***400***. Conversely, the lower diagram shows the rod ***206*** in an extended position to insert the rod into the holes ***206***, ***208*** and thereby prevent use of the handle ***202*** and removal of the drive ***200*** from the bay ***400***. When the drive ***200*** is fully inserted into the drive bay ***200*** to couple electronics (not shown) of the drive to electronics (not shown) in the drive bay, the handle ***202*** is positioned downward as shown with the hole ***206*** in a position to receive the rod ***406***.

[022] A release switch ***408*** is positioned on a front edge of the drive bay ***400*** and is electrically coupled to electronics (not shown) in the drive bay. When the switch ***408*** is activated by a user, electronics within a computer system (not shown), of which the drive bay is a part, place the removable drive ***200*** into a condition safe for removal and communicate with the interlock mechanism ***402*** to withdraw the rod ***402*** and thereby allow the user to remove the drive using the handle ***202***, as will be discussed in more detail below.

[023] **FIGS. 5A** and **5B** are cross-sectional views illustrating the operation of the multifunction handle ***202*** of **FIG. 2** in inserting the removable drive ***200*** within the drive bay of **FIG. 4**. In **FIG. 5A**, a force **F** is applied to the handle ***202*** to rotate the handle downward (i.e., counterclockwise) about the axis ***300*** as indicated by arrow ***500***. As the handle ***202*** is rotated downward, a front portion ***502*** of the insertion cam ***306*** contacts an inner front portion ***504*** of the drive bay ***400***, pushing the removable drive ***200*** into the drive bay as indicated by arrow ***506***. **FIG. 5B** shows the handle rotated fully downward, with the force **F** of the front portion ***502*** of insertion cam ***306*** pushing the drive ***200*** into its fully inserted position within the drive bay ***400***. At this point in **FIG. 5B**, the side member ***216*** of handle ***212*** is positioned vertically with the hole ***206*** positioned to receive the rod ***406*** (not shown) of the interlock mechanism ***402***. Once the rod ***406*** extends through the hole ***206***, the handle ***202*** is secured in the position shown in **FIG. 5B** and may not be used to remove the drive ***200*** from the bay ***400***.

[024] **FIG. 6** is a functional block diagram of a computer system ***600*** including the removable drive ***200*** and drive bay ***400*** of **FIG. 4** according to one embodiment of the present invention. The removable drive ***200*** is coupled through the drive bay ***400*** to computer circuitry ***602*** to provide for writing data to and reading data from

the removable drive, and also for controlling the interlock mechanism ***402*** (**FIG. 4**), as will be described in more detail below. The computer circuitry ***602*** also includes memory, such as dynamic random access memory (DRAM), and includes circuitry and operating system software for performing various computing functions, such as executing specific application software to perform specific calculations or tasks. Although the computer system ***600*** is shown as including only one removable drive ***200*** and associated drive bay ***400***, a plurality of removable drives and associated drive bays may be included in the computer system ***600***.

[025] The computer system ***600*** further includes one or more input devices ***604***, such as a keyboard or a mouse, coupled to the computer circuitry ***602*** to allow an operator to interface with the computer system. Typically, the computer system ***600*** also includes one or more output devices ***606*** coupled to the computer circuitry ***602***, such as a printer and a video terminal. One or more data storage devices ***608*** are also typically coupled to the computer circuitry ***602*** to store data or retrieve data from external storage media (not shown). Examples of typical storage devices ***908*** could include floppy disks, tape cassettes, compact disk read-only (CD-ROMs) and compact disk read-write (CD-RW) memories, digital video disks (DVDs), and permanently installed hard drives.

[026] The overall process of the insertion and removal of the removable drive ***200*** into and from the computer system ***600*** will now be described in more detail with reference to **FIGS. 2 - 6**. Assume the drive ***200*** is initially not inserted into the drive bay ***400***. In this situation, the rod ***406*** of the interlock mechanism ***402*** is in the retracted position. A user then inserts the removable drive ***200*** into the drive bay ***200*** and pushes the drive toward the back of the bay, using the handle ***202*** and/or pushing on the front panel ***308*** of the drive. Once the drive ***200*** is nearly fully inserted into the drive bay ***400***, roughly in the position shown in **FIG. 5B**, the handle ***202*** is rotated downward. As the handle ***202*** is rotated downward, insertion cams ***306*** push against the inner front portion ***504*** of the drive bay ***400***, pushing the drive ***200*** fully into position within the drive bay and thereby coupling electrical connectors (not shown) on a back of the removable drive ***200*** to electrical connectors (not shown) at the back of the drive bay ***400***.

[027] At this point, the handle ***202*** is rotated fully downward as shown in **FIGS. 4** and **5B**. The computer circuitry ***602*** detects that the drive ***200*** has been inserted into the drive bay ***400***, and activates the interlock mechanism ***402*** to extend the rod ***406*** through the holes ***206***, ***208*** and secure the drive within the bay. The removable drive ***200*** is in this way coupled to the computer system ***600***, and cannot be inadvertently removed by a user. For example, if an operating system running on the computer system ***600*** stores a file system information structure of the drive ***200*** in cache memory within the computer circuitry ***602***, the drive cannot simply be pulled out of the bay ***400*** without the operating system having updated the file system information structure stored on the drive.

[028] The removal of the drive ***200*** may then occur in at least two different ways. First, the release switch ***408*** may be activated by a user wishing to remove the drive ***200*** from the computer system ***200***. In response to the switch ***408*** being activated, the operating system or other suitable program in the computer circuitry ***602*** first updates the file system information structure on the drive using the file system information structure stored in cache memory, if necessary. The operating system or other program thereafter deactivates the interlock mechanism ***402***, causing the rod ***406*** to withdraw from the holes ***206***, ***208***. Once the rod ***406*** is withdrawn from the holes ***206***, ***208***, a user rotates the handle upward, disengaging the insertion cams ***306*** and the inner front portions ***504*** of the drive bay ***400*** and allowing the user to pull the drive out of the bay. Another way the drive ***200*** could be removed is for a user to select through a "soft switch" on display of the computer system ***600*** the desire to remove the drive from the system. In response to this selection, the operating system or other program would then deactivate the interlock mechanism ***402*** and a user would remove the drive from the bay ***400*** in the same way as just described.

[029] Although the removable drive ***200*** is described as being a removable mass storage device, the removable drive could be another type of removable device as well. Also, although the handle ***202*** is shown and described as having a specific structure, one skilled in the art will realize that the handle may assume a variety of alternative and equivalent structures. For example, although the handle ***202*** is

shown as rotating in an upward and downward direction in the described embodiments, in other embodiments the handle could function in a side-to-side manner to perform the same insertion and interlock functions in conjunction with the interlock mechanism ***404***. The handle ***202*** may be formed from a variety of structures suitable for performing the desired insertion and interlock functions. Similarly, the interlocking mechanism ***402*** may be a variety of different structures, with the specific structure of the interlocking mechanism being selected to perform the desired function in conjunction with the particular handle ***202*** structure being utilized. Such alternative and equivalent structures for the handle ***202*** and interlocking mechanism ***402*** will be understood by those skilled in the art, and should be considered aspects of the present invention.

[030] Even though various embodiments of the present invention have been set forth in the foregoing description, the above disclosure is illustrative only, and changes may be made in detail and yet remain within the broad principles of the present invention. One skilled in the art will appreciate that the example embodiments described above do not limit the scope of the present invention, and will also understand various modifications, equivalents, and combinations of such embodiments are within the scope of the present invention. Therefore, the present invention is to be limited only by the appended claims.